EXECUTIVE SUMMARY OF MAIN POINTS

1. THE SURREY METHOD

A larger sample and more years post introduction of safety audit are desirable. A more accessible data base is necessary. However, the basic data handling and approach seems satisfactory, making use of grid coordinates to define each scheme and using the Accident Investigation System (AIS) of the Land Transport Safety Authority (LTSA).

It appears that safety audits at busy or urban locations are more likely to yield results using this system.

It is recommended that a data base be set up, that a sample of urban safety audits (and unaudited sites) in Manukau be investigated, and that in the longer term more urban (local authority) safety audits be undertaken.

2. THE CORBEN METHOD

This method requires the availability of factors in order to ascribe potential accident savings from the detection and removal of problems by using safety audit. No such list exists. There is, however, a series of published notes by the LTSA which is potentially useable. Whether these data can be directly translated into use as predictive (or crashes saved) factors in safety audit is not certain, but they are the best available source at present. Possibly a further study, or monitoring of sites over a long period, will demonstrate their applicability.

Bearing in mind these present uncertainties, a more direct method of expressing the potential for crash savings was investigated. This resulted in a method of assigning degrees of severity to observed problems. This approach has the capability of being related to audited sites(and unaudited sites, based on inspection), potential reductions in accidents, and the efficiency of safety audit in detecting and getting problems fixed.

It is recommended that the system be further investigated, including the application of the system to a larger sample of actual safety audits. It would be worthwhile investigating the use of accident factors for a range of problems and relating these to the savings resulting from accident investigation studies published by the land Transport safety Authority. To facilitate gaining information, safety audits of more accident prone locations (eg urban or more complex schemes) should be investigated.

3. MEASURING AWARENESS OF SAFETY AUDIT AND OF SAFE DESIGN

It is recommended that a questionnaire based on the example should be distributed with the "Roundabout" magazine to all Transportation group members, and the results analysed. It should be possible to relate the findings to the organisations using the method or requesting safety audits.

4. A DATA BASE OF SAFETY AUDITED SCHEMES

One possible way of achieving this appears to be the addition of a field to the present AIS system. There may be other means including the creation of a stand-

alone but related data base. The British Transport Research Laboratory is investigating the creation of a data base. Surrey appears to have one in operation. The topic needs fuller investigation before a recommendation can be made. It does seem common to all potential methods that all traffic and roading schemes should be defined by national grid coordinates.

5. THE EFFICIENCY OF SAFETY AUDIT

It has been recommended that the method of assigning factors to safety audit problems be further investigated to determine if, over an adequate period, the individual or total degrees of severity can be related to accidents, using the data base of safety audits. This may then give an indication of shortfalls in detecting and reporting problems. However, it is not the purpose of this overview research project to propose any methodology for measuring the efficiency of safety audits or safety auditors, though this may well be a topic worth pursuing (including, for instance, the accreditation of safety auditors either in general or in specialist fields).

6. QUALITY AND ADEQUACY OF DATA

One outcome of the research has been some concern at the quality of data. There is evidence of serious under reporting of rural accidents.

It is might be worthwhile studying a sample of locations to see if St. John's Ambulance or Hospital Emergency admission data is a practical basis or supplementary method for assisting the measurement of the benefits of safety audits.

Urban safety audits, with usually more accidents and probably more potential for change, appear to offer the most useful group for research, irrespective of the source of the data. The reporting rate is higher than for rural locations.

7. THE MOST FRUITFUL GROUP FOR SAFETY AUDITS - AND RESEARCH.

One corollary of this statement is that it would be desirable from many points of view to increase the number of urban or complex safety audits; the research showed that most of the safety problems encountered were in that group. Some rural safety audits yield so little in the way of problems that the resources might be better used in urban locations.

It is also observable that problems are more likely to be missed or misinterpreted in urban or complex audits. This is logical considering the relatively straight forward nature of many rural shape corrections, compared to, say a major roundabout design. The methods of addressing this issue lie outside the scope of this research but these comments are appropriate if efficiency is considered an important aspect of safety audit.

APPENDIX

A1. Schemes checked in the AIS data base of the LTSA. Grid coordinates and radii.

The following is a summary of the schemes checked with the grid coordinate definition selected.

Description	Construction Year	District	Eastings	Northings	Radius
Sullivan's Elbow - Giants Grave	1994	Westland	238-7400	592-7700	800m
Saltwater Creek	1995	Waimakirir	248-5350	577-0750	1000m
Conway North	1992	Kaikoura	254-4300	584-5800	500
Buntings Creek	1995	Kaikoura	254-2500	584-4500	300
Broken River Bridge and approaches	1994	Selwyn	240-7150	577-8300	1000
St Ann's Lagoon	1994	Hurunui	253-2300	582-4700	500

Table A1 - Schemes selected, basis of addressing data base

A2 The two roundabouts in Christchurch

As an addendum to this research the experience was valuable and the following points are of importance.

1. On the scale of severity of problem used in the modified Corben Method, one roundabout scored 4 serious problems (4 points each) and a number of lesser problems in a stage 4 safety audit. There had been a previous (stage 3) safety audit which did not identify all problems. The second roundabout scored one serious problem (4 points) and also a number of lesser problems. There had been a previous stage 3 audit in this case too.

A3 Examples of lists of problems

The following lists are included as examples of coding ability for safety audit problems.

The first is the current recommendations coding sheet of the LTSA. The second is the quick reference chart for the accident monitoring system. It has been suggested that a seventh topic under "ACTION IMPLEMENTATION STATUS CODES" could be included to bring in the topic of safety audit.

Lastly, the checklist adapted for this project and used to log both problems and assign points representing the seriousness of the problem.

RECOMMENDATION CODING SHEET

ACTION CATEGORY	ACTION	Action Code	OBJECT	Object Code
OBJECT CATEGORY = SURFACE & LAYOUT				**100**
Add/Install	Install	11	Bridge	101
	Seal	13	Carriageway/lanes	102
Move	Move	31	Crawler/passing lane	103
Upgrade/Maintain	Upgrade	41	Driveway	104
	Re-seal	42	Flush median - see section 200	
Modify	Ban/close	51	Intersection	105
	Extend	52	Physical bay - Left turn	106
	Shorten	53	Physical bay - Right turn	107
	Narrow	54	Physical bay - Parking	108
	Widen	55	Ramp	109
	Lower	56	Shoulder	110
	Raise	57	Taper	111
	Re-design	58		
OBJECT CATEGORY = MARKINGS & DELINEATION				**200**
Install/Add	Install	11	Bridge end marker	201
	Paint/mark	12	Bus stop	202
Remove	Remove	21	Centreline - dashed	203
Move	Move	31	Centreline - solid	204
	Re-align	32	Chevrons - single curve indicators	205
Upgrade/Maintain	Upgrade	41	Chevron board - full	206
	Maintain paint	43	Continuity line	207
	Replace	45	Diagonal marks	208
Modify	Extend	52	Edgeline	209
	Shorten	53	Edge marker posts	210
	Narrow	54	Flush median	211
	Widen	55	Guard rail - see section 600	
	Lower	56	Hatched/painted island	212
	Raise	57	Hazard marker	213
	Increase(#of)	59	Lane markings - general	214
			Lane markings - arrows	215
			Lane markings - cycle lane	216
			Lane markings - left turn lane	217
			Lane markings - right turn lane/bay	218
			Limit lines	219
			No overtaking line	220
			No stopping line	221
			Parking space - painted	222
			Pedestrian crossing	223
			RRPMs	224
			Sight rail	225
			Words	226
OBJECT CATEGORY = LIGHTING				**300**
Install/Add	Install	11		
Move	Move	31		
Upgrade/Maintain	Upgrade	41		
	Repair	44		
	Replace	45		
Modify	Extend	52		

ACTION CATEGORY	ACTION	Action Code	OBJECT	Object Code
OBJECT CATEGORY = TRAFFIC SIGNS				**400**
Install	Install	11	Refer to "MANUAL of	
Remove	Remove	21	TRAFFIC SIGNS AND	
Move	Move	31	MARKINGS Part I: Traffic Signs"	
Upgrade/Maintain	Repair	44	and code signs accordingly,	
	Replace	45	eg. Stop sign is code RG-5	
Modify	Lower	56		
	Raise	57		
	Increase (#of)	59		
	Decrease (#of)	60		
	Enlarge	61		
OBJECT CATEGORY = KERBS, ISLANDS, & MEDIANS				**500**
Install/Add	Install	11	Bulbous kerbs	501
	Paint/mark	12	Flush median - see section 200	
	Seal	13	Hatched/painted island - see section 200	
Remove	Remove	21	Kerb	502
Move	Move	31	Median barrier-see section 600	
	Re-align	32	Pedestrian refuge	503
Upgrade/Maintain	Re-seal	42	Raised median	504
	Maintain paint	43	Roundabout- see section 800	
	Repair	44	Seagull/splitter island	505
	Replace	45	Speed hump	506
Modify	Extend	52	Throat/fishtail island	507
	Shorten	53		
	Narrow	54		
	Widen	55		
	Lower	56		
	Raise	57		
OBJECT CATEGORY = ROADSIDE FEATURES				**600**
Install/Add	Install	11	Building	601
	Paint/mark	12	Cliff/bank	602
	Seal	13	Ditch	603
	Plant	14	Fence	604
Remove	Remove	21	Footpath	605
Move	Move	31	Guard rail	606
	Re-align	32	Median barrier	607
Upgrade/Maintain	Re-seal	42	Poles	608
	Maintain paint	43	Trees/vegetation	609
	Repair	44		
	Replace	45		
Modify	Extend	52		
	Shorten	53		
	Narrow	54		
	Widen	55		
	Lower	56		
	Raise	57		
	Trim	62		

ACTION CATEGORY	ACTION	Action Code	OBJECT	Object Code
OBJECT CATEGORY = TRAFFIC FLOW				**700**
Install/Add	Allow	15	Left turn vehicles	701
Remove	Remove	21	Right turn vehicles	702
			Parked vehicles	703
OBJECT CATEGORY = CONTROL TYPES				**800**
Install/Add	Install	11	Give way control	801
	Paint/mark	12	Stop control	802
Remove	Remove	21	Limit lines - refer to Section 200	
Move	Move	31	Roundabout	803
Upgrade/Maintain	Upgrade	41	Speed limit	804
	Maintain paint	43	One-lane bridge control	805
	Repair	44	Railway barrier	806
	Replace	45	Traffic signal (T.S.) Control	807
Modify	Extend	52	T.S. (Upgrade to) NAASRA/NZ Stnd	808
	Shorten	53	T.S. Phasing	809
	Narrow	54	T.S. Other	810
	Widen	55		
	Lower	56		
	Raise	57		
	Increase (# of)	59		
	Enlarge	61		
	Shade	63		
	Change	64		
OBJECT CATEGORY = GEOMETRIC ALIGNMENT				**900**
Move	Re-align	32	Crest	901
Upgrade/Maintain	Upgrade	41	Curve	902
Modify	Extend	52	Depression	903
	Increase	59	Sag	904
	Decrease	60	Superelevation/camber	905
	Ease	65		

LAND TRANSPORT SAFETY AUTHORITY

May 1994

MONITORING DATA ENTRY REFERENCE

F2	Choose study
F3	Choose site within current study
F6	Duplicate site
Alt F6	Re-number site
F7	Delete site
F8	Save site and input new IDNO
F9	Save site
F10	Cancel edit and enter new IDNO
Esc	Exit

Moving between screens

F5	Jump to and from Problems and Actions section
PgDn	Move down a screen within the site
PgUp	Move up a screen within the site
Ctrl PgUp	Move to previous site
Ctrl PgDn	Move to next site

Moving within a screen

F4	Jump between fields
Enter or Tab	Move forward through the fields, in the order they are defined
Shift Tab	Move back through the fields, in the order they are defined
Shift →	Move across rows
Shift ←	Move back across rows
↑	Move up columns
↓	Move down columns

ACCIDENT SELECTION METHODS

		I	N	R	A
1	Grid reference and radius	✓	✓	✓	✓
2	Route position range				
3	Digitised Area	✓	✓	✓	✓
4	Digitised Route		✓	✓	
5	Multi-part digitised route			✓	
6	Street names			✓	
7	Street names within a grid reference box	✓	✓	✓	✓
8	Grid reference box	✓	✓	✓	✓

ACTION IMPLEMENTATION STATUS CODES

1 Implemented - a date is required.
2 Not implemented.
3 Monitor only - no longer available.
4 Will not be done - the action was recommended, but will not be implemented.
5 Works completed not as part of AI study - a date is required.
6 Additional works have been done at the site, but are not considered to supersede other works - no date is necessary.

SITE IMPLEMENTATION STATUS

1 Site fully implemented, all implementation dates known.
2 Not fully implemented.
3 Monitor only - no longer available.
4 No actions will be implemented.
5 Works completed not as part of Accident Investigation study recommendations.
6 Site fully implemented, some implementation dates are still unknown.
7 Site fully implemented, but all implementation dates are unknown.

ACCIDENT INVESTIGATION MONITORING SYSTEM

QUICK REFERENCE CHART

Road Controlling Authority

1 Local Authority
2 Transit New Zealand

PROBLEM CODING SHEET

ACCIDENT TYPE		OPTIONAL DETAILS	
All/general	1	Darkness	1
Overtaking	2	Wet Road/Ice	2
Head-on (bend)	3	Struck roadside object	3
Head-on (straight)	4	Speed	4
Lost Control (bend)	5	Cyclist	5
Lost Control (straight)	6		
Rear-End/Obstruction	7		
Crossing	8		
Turning	9		
Merging	10		
Pedestrian	11		
Other	12		

LAND TRANSPORT SAFETY AUTHORITY

May 1994

SAFETY AUDIT APPRAISAL SHEET

NAME OF SCHEME STAGE DATE

PRESENCE & SEVERITY OF PROBLEM→ / TOPICS LIST ↓	FAULT PRESENT? (enter 1)	4 VERY SERIOUS	3 SERIOUS	2 MODERATE	1 MINOR	SUM
1a. Issues and general conditions						
1. Changes since previous stages						
2. Drainage						
3. Climatic conditions						
4. Landscaping, general						
5. Services - buried and overhead						
6. Access to property and development						
7. Future widening &/or realignments						
8. Staging of scheme						
9. Staging of works						
10. Significant adjacent developments						
11. Batter & fill stability incl. surface effects						
1b General or Sch. Design approach						
13. Geom. of horizontal & vertical alignment						
14 Appropriateness of design speed adopted						
15. Typical cross sections, adequacy						
16. Effect of Cross Sectional Variation						
17. Roadway layout for traffic management						
18. Shoulders, edge treatment, k'side controls						
19. Departure from Standards & Guidelines						
20. Visibility, sight distances						
21. Signs and markings						
22. Surface, skid resistance						
23.Contrast with markings						
24. Installed hazards						
25. Natural features						
INTERIM TOTALS						

PRESENCE & SEVERITY OF PROBLEM→ / TOPICS LIST ↓	FAULT PRESENT? (enter 1)	4 VERY SERIOUS	3 SERIOUS	2 MODERATE	1 MINOR	SUM
2. Local Alignment incl. Intersections						
1. Visibility						
2. Readability by drivers & other users						
3. Correctness of speed design						
4. New/existing road Interface						
5. Relationship to other nearby intersections						
6.Layout, geom. des. incl. pavmnt markings						
7. Traffic signals						
8. Stop and give way signs						
9. Roundabouts, islands, ped. refuges						
10. Traffic restrs, tr. calming (all roads)						
3. Objects - be struck/limit design						
1. Median barriers						
2. Poles & similar obstructions						
3. Guardrailing (vehicle or pedestrian)						
4. Bridge & culvert parapets, underp.soffits						
5.. Solid Vegetation						
6. Verandahs						
4. Assist User -Signs and Lighting						
1. Lighting						
2.Traffic Signs - pos. & appropropriateness, size						
2. Other Signs - incl. distractive (non-road)						
3. Markers, edge delineation						
5. Construction and operation						
1. Buildability						
2. Operation						
3. Traffic Management						
4. Network Management						
5. Temporary traffic control / Management						
6. By-law requirements (P)						
6. Safety aspects not covered						
Grand Totals						

PREVIOUS AUDIT? Y/N

STATE STAGE(S)

COMMENTS

Person preparing this sheet / date

A4 Analysis of safety audits and observed problems

The following tables summarise the points allocated to problems observed either in safety audits or on site.

The logging of problems and allocation of points was made using the first list above.

Brief comments are given where appropriate. For fuller information the actual coded sheets are available.

This method is only being investigated at this stage but it is clear that some safety audits reveal more problems of a more serious nature than others. Perhaps a high score (say, more than 20 points) indicates that the audit was well worth the effort, particularly if the client takes note and requests that the plans be amended.

ANALYSIS OF SAFETY AUDITS AND SITE OBSERVATIONS **Benefits of Safety Audit**

Sheet 1 - Transit New Zealand schemes **(Modified "Corben" Method)** MLG 20/12/96

Name of scheme		Problems found in:						
Broken River		Safety audit 1		Safety audit 1		Site Inspection		Comments
SH73	Minor (1 point)		0		0	1	1	Channels
	Moderate (2 points)		0		0	3	6	access on bend,
Transit New Zealand	Serious (3 points)		0		0		0	speed value
	Very Serious (4 points)		0		0		0	
	Totals found/points	0	0	0	0	4	7	***Not safety audited***
Name of scheme		Problems found in:						
Buntings Creek		Safety audit 1		Safety audit 2		Site Inspection		Comments
SH1	Minor (1 point)	1	1	2	2	1	1	
	Moderate (2 points)	6	12	2	4		0	drains, ice, narrowness
Transit New Zealand	Serious (3 points)		0		0		0	***(St 2 & st. 4 audits)***
	Very Serious (4 points)		0		0		0	
	Totals found/points	7	13	4	6	1	1	site ins only narrowness
Name of scheme		Problems found in:						
Conway North		Safety audit 1		Safety audit 2		Site Inspection		Comments
SH1	Minor (1 point)		0		0		0	
	Moderate (2 points)		0		0		0	
Transit New Zealand	Serious (3 points)		0		0	1	3	Poor readability of
	Very Serious (4 points)		0		0		0	curve
	Totals found/points	0	0	0	0	1	3	***Not safety audited***
Name of scheme		Problems found in:						
Harewood Road		Safety audit 3		Safety audit 4		Site Inspection		Comments
Roundabout SH1	Minor (1 point)	1	1	2	2	2	2	See text.
	Moderate (2 points)	5	10	3	6	3	6	st 3 not acted on
Transit New Zealand	Serious (3 points)	2	6	4	12	4	12	poor temp signs
	Very Serious (4 points)	2	8	4	16	4	16	design faults
	Totals found/points	10	25	13	36	13	36	***Site insp=st4 audit***
Name of scheme		Problems found in:						
Harris Creek to		Safety audit 1		Safety audit 1		Site Inspection		Comments
Donegals SH73	Minor (1 point)		0		0	2	2	***Not safety audited***
	Moderate (2 points)		0		0		0	
Transit New Zealand	Serious (3 points)		0		0		0	(Minor concerns at
	Very Serious (4 points)		0		0		0	intersection and
	Totals found/points	0	0	0	0	2	2	contrast of markings)
Name of scheme		Problems found in:						
St. Annes Lagoon		Safety audit 1		Safety audit 1		Site Inspection		Comments
SH1	Minor (1 point)		0		0		0	
	Moderate (2 points)	4	8		0	1	2	Only remain concern
Transit New Zealand	Serious (3 points)	4	12		0		0	speed of curves
	Very Serious (4 points)		0		0		0	***(st 4 audit: all to do***
	Totals found/points	8	20	0	0	1	2	***with poor finish)***
Name of scheme		Problems found in:						
Saltwater Creek		Safety audit 1		Safety audit 1		Site Inspection		Comments
SH1	Minor (1 point)	2	2		0	1	1	Access **(SA &Inspn)**
	Moderate (2 points)	1	2		0		0	Surface **(SA only)**
Transit New Zealand	Serious (3 points)	2	6		0		0	Speed design **(" ")**
	Very Serious (4 points)		0		0		0	*(Traffic behaviour not*
	Totals found/points	5	10	0	0	1	1	*always to design)*
Name of scheme		Problems found in:						
Sulivans Elbow to		Safety audit 1		Safety audit 1		Site Inspection		Comments
Giants Grave SH73	Minor (1 point)		0		0	1	1	Shoulder rounding
	Moderate (2 points)		0		0	1	2	farm paddock access
Transit New Zealand	Serious (3 points)		0		0		0	
	Very Serious (4 points)		0		0		0	
	Totals found/points	0	0	0	0	2	3	***Not safety audited***

ANALYSIS OF SAFETY AUDITS AND SITE OBSERVATIONS Benefits of Safety Audit

Sheet 2 - Christchurch C. C. Schemes **(Modified "Corben" Method)** MLG 20/12/96

All were safety audited

Name of scheme		Problems found in:						
Avonside Drive		Safety audit st3				Site Inspection		Comments
	Minor (1 point)		0		0		0	
	Moderate (2 points)	5	10		0		0	2la-1
Christchurch City	Serious (3 points)	2	6		0		0	no cut downs
	Very Serious (4 points)		0		0		0	
	Totals found/points	7	16	0	0	0	0	Apparently accepted
Name of scheme		Problems found in:						
Colombo/Tennyson		Safety audit st3				Site Inspection		Comments
	Minor (1 point)	1	1		0		0	access
	Moderate (2 points)	4	8		0		0	bus stop, parking
Christchurch City	Serious (3 points)		0		0		0	
	Very Serious (4 points)		0		0		0	
	Totals found/points	5	9	0	0	0	0	acted on
Name of scheme		Problems found in:						
Dilworth/Clarence		Safety audit st3				Site Inspection		Comments
	Minor (1 point)		0		0		0	
	Moderate (2 points)	1	2		0	1	2	Slip la.Danger to peds
Christchurch City	Serious (3 points)	1	3		0	1	3	Dilworth cross move
	Very Serious (4 points)		0		0		0	
	Totals found/points	2	5	0	0	2	5	not acted on
Name of scheme		Problems found in:						
Halsell junc rd		Safety audit st3		Safety audit st4		Site Inspection		Comments
Roundabout	Minor (1 point)		0	1	1		0	
	Moderate (2 points)	2	4	2	4		0	lack of defln. (stays)
Christchurch City	Serious (3 points)	2	6	1	3		0	Modify rdbt
	Very Serious (4 points)		0	1	4		0	design faults stay
	Totals found/points	4	10	5	12	0	0	*some accepted*
Name of scheme		Problems found in:						
Moorhouse Avenue		Safety audit st2				Site Inspection		Comments
six laning	Minor (1 point)	2	2		0	2	2	
	Moderate (2 points)	5	10		0		0	laning
Christchurch City	Serious (3 points)	5	15		0		0	slip lane
	Very Serious (4 points)		0		0		0	rt turn filter
	Totals found/points	12	27	0	0	2	2	*most accepted*
Name of scheme		Problems found in:						
Northcotre expway		Safety audit st2		Safety audit st4		Site Inspection		Comments
	Minor (1 point)		0	4	4		0	
	Moderate (2 points)	3	6	4	8	1	2	st 2 comments disputed
Christchurch City	Serious (3 points)	1	3		0		0	design OK.
	Very Serious (4 points)		0		0		0	St 3 - mainly guardrailing
	Totals found/points	4	9	8	12	1	2	*fixed.*

PILOT QUESTIONNAIRE
CONTRACT REPORT

Contract Reports. Methods for determining the benefits of safety audit. A scoping study
Final reports: 19 June 1997

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BENEFITS OF SAFETY AUDIT

QUESTIONNAIRE TO MEMBERS OF THE TRANSPORTATION GROUP

ANALYSIS OF RESPONSES

M. L. Gadd - May 1997

5/23/97

BENEFITS OF SAFETY AUDIT
QUESTIONNAIRE TO MEMBERS OF THE TRANSPORTATION GROUP
ANALYSIS OF RESPONSES
M. L. Gadd

CONTENTS

BENEFITS OF SAFETY AUDIT

QUESTIONNAIRE TO MEMBERS OF THE TRANSPORTATION GROUP

ANALYSIS OF RESPONSES

M. L. Gadd

1. PURPOSE

The objective of the survey was to trial the methodology and if possible determine the use of safety audit in the group, also awareness of topics and comparisons between those involved in geometric design and not-involved persons. The opportunity would also be taken to seek comments on several aspects of safety audit.

2 RESPONSE RATE

Four hundred questionnaires with stamped addressed envelopes were delivered to members of the group with the February 1997 copy of the "Roundabout" group newsletter. When this final report was written, 98 responses had been received ie a response rate of just under 25%.

3. INVOLVEMENT OR ASSOCIATION WITH SAFETY AUDIT

74 of the responses were from persons seriously involved in geometric design or traffic management. 24 were not. Most of the involved group made a positive response to questions 7 and 8 which sought awareness of safety audit and topics of which the respondent was now more aware. The summary details of the answers to questions 1 -7 and 9 and 10 of are given in tables 1a (involved in road geometry) and 1b (not involved in road geometry). The questionnaire distributed is reproduced as appendix 1...

The number of safety audits claimed to have been carried out by respondents ranged from 0 (16 responses) to 180. Figure 1, below, illustrates the distribution which indicates that a relatively small number of respondents are doing a large number of safety audits, with a large number of respondents doing only a few, ie there has possibly been a degree of "market capture" by a few firms and individuals. (It is not suggested that this is either bad or good, a secondary survey would be needed to target both the doers and the clients to determine the perceived quality of work. There are, however, a large number of comments about perceived shortcomings of the system or teams)

73% of the involved group responding had been on a safety audit. Interestingly, 18% of those not involved with geometric design had also been on a safety audit. It could be inferred that the teams are drawn from a wide range of sub groups of traffic engineering. This may be a good thing, but as already mentioned there are adverse comments about the quality of audits and teams so possibly not all participants had received pre-training (or could actually be training on the job).

4. USE OF SAFETY AUDIT BY ORGANISATIONS

72% of all employers (or consultants) were reported as employing safety audit, 57% frequently, 17% seldom, 7% never and 3% did not specify or didn't know.

Of the employers or consultants principal) who carried out safety audits, the sample ranged from 100% to 2. This rate of carrying out safety appears high since Transit new Zealand only require 20% of jobs to be audited. The conclusion is, once again, that some organisations are getting the lion's share of the contracted out safety audit work.

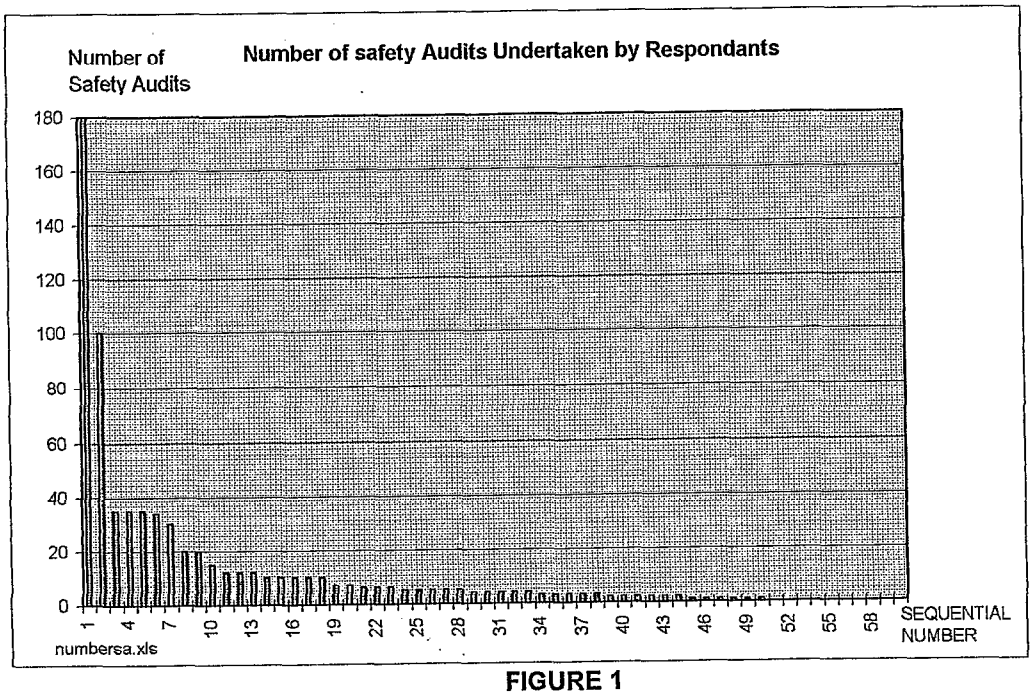

FIGURE 1

Interestingly, Transit new Zealand employee's responses to this question also exceed 20% where responded to (70,60,50,50,25, with two did not reply). It could be concluded that TNZ is, on average, auditing 50% of jobs, unless some employees are participating in safety audits not related to their office. The questionnaire did not attempt to draw this distinction, being only concerned in the numerical involvement.

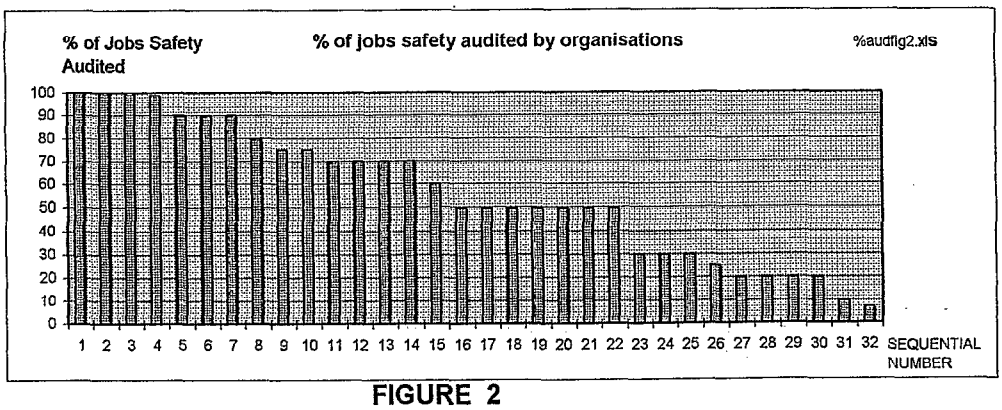

FIGURE 2

Consultants carrying out safety audits ranged widely in their involvement, but a few once again seemed to be doing much of the

work. Works Consultancy ranged from 30 - 75% of jobs with which they were involved, though how the % was estimated is uncertain without a follow up.

It could be deduced that at these organisations a high percentage of the work load with which an employee was involved consisted of safety audits.

Of major city Councils, respondents from Christchurch ranged from 70 - 100% (70,90,99,100). It is an interesting observation that employees have differing opinions about their office's involvement.

Manukau City audited 70% of jobs.

No attempt has been made as yet to determine other local government ofiice's involvement but it appears to be much less, certainly compared with the two organisations just mentioned.

5. ATTENDANCE AT A SAFETY AUDIT COURSE

53% of those replying had attended a course, 44% had not and the balance were unclear. Of the geometrically involved group 59% had been on a course, and of the non-geometrically involved group 36% had been on a course. Even allowing for the selective nature of the sample, it seems that attendance at courses is reasonably high.

6 INCREASED AWARENESS OF SAFE DESIGN PRACTICE, AND TOPICS

69% of the group were more aware of safe design practice, 16% were not, and 3% not clear. (As is usually the case, not all answers were responded to, in this case 12%)

93% of those responding claimed to understand the practice of safety audit. It would be necessary to sample the members of the Transportation Group who did not respond to determine the total understanding of safety audit by the group as a whole. It seems likely that the 25% who responded did so because they were sufficiently interested in the topics to do so.

Table 2 lists the % responses to the list of topics circulated with the questionnaire, in descending order of response.

The top ten topics of which greater awareness were traffic signs, visibility, signs and markings, readability, roundabouts, horizontal and vertical design, speed design adopted, geometry generally, poles or similar obstructions, and lighting.

The list is interesting as it could be used to indicate which topics deserve special attention in designs, and conversely, those which are not significant or are being dealt with satisfactorily

Question		Response, Number	Response, %
1. Are you aware of safety audit?	y	73	100
	n	0	0
2. Are you involved in Geom. des. of roads?	y	69	95
	marginally	5	7
	n	0	0
Specifically traffic management?	y	64	88
	n	5	7
road layouts	y	66	90
	n	5	7
safety studies	y	59	81
	n	4	5
3. Does your employer use the practice of sa?	y	57	78
	n	2	3
Specifically frequently?		45	62
seldom		13	18
never		6	8
don't know		2	3
Estimate % of jobs audited		1513	21
4. Do you understand the practice of sa?	y	70	96
	n	2	3
5. Have you attended a course on this topic?	y	43	59
	n	28	38
6. Have you been on a safety audit?	y	53	73
	n	19	26
How many?		674	9
7.Are you now more aware of safe design practice?	y	51	70
	n	11	15
	Not Sure/don't know	3	4
9. Are you aware of any shortcomings of the method	y	14	19
	n	17	23
Any suggestions as to how these can be remedied		8	11
10. Has sa had a beneficial effect on non sa schemes	y	16	22
	n	11	15
	qualified d.k.	3	4

RESPONSES TO QUESTIONS 1-7 & 9,10, WHERE INVOLVED IN GEOMETRY
TABLE 1A

Question		Response, Number	Response, %
1. Are you aware of safety audit?	y	17	77
	n	4	18
2. Are you involved in Geom. des. of roads?	y	0	0
	marginally	0	0
	n	22	100
Specifically traffic management?	y	1	5
	n	13	59
road layouts	y	0	0
	n	14	64
safety studies	y	0	0
	n	12	55
3. Does your employer use the practice of sa?	y	13	59
	n	5	23
Specifically frequently?		10	45
seldom		3	14
never		1	5
don't know		1	5
Estimate % of jobs		213	10
4. Do you understand the practice of sa?	y	19	86
	n	3	14
5. Have you attended a course on this topic?	y	8	36
	n	14	64
6. Have you been on a safety audit?	y	4	18
	n	17	77
How many?		57	3
7.Are you now more aware of safe design practice?	y	13	59
	n	5	23
	Not Sure/don't know	2	9
9. Are you aware of any shortcomings of the method	y	8	36
	n	5	23
Any suggestions as to how these can be remedied		7	32
10. Has sa had a beneficial effect on non sa schemes	y	12	55
	n	0	0
	qualified d.k.	6	27

RESPONSES TO QUESTIONS 1-7 & 9,10, WHERE NOT INVOLVED IN GEOMETRY
TABLE 1B

Field	Description and number of field	Total	Percent of returns
4	2.Traffic Signs - pos. & appropropriateness, size	48	50%
1b	20. Visibility, sight distances	37	39%
1b	21. Signs and markings	36	38%
2	2. Readability by drivers & other users	36	38%
2	9. Roundabouts, islands, ped. refuges	36	38%
1b	13. Geom. of horizontal & vertical alignment	35	36%
1b	14 Appropriateness of design speed adopted	35	36%
2	6.Layout, geom. des. incl. pavmnt markings	35	36%
3	2. Poles & similar obstructions	33	34%
4	1. Lighting	32	33%
2	4. New/existing road interface	31	32%
2	10. Traffic restrs, tr. calming (all roads)	31	32%
1b	18. Shoulders, edge treatment, k'side controls	30	31%
3	3. Guardrailing (vehicle or pedestrian)	29	30%
1b	19. Departure from Standards & Guidelines	28	29%
1b	24. Installed hazards	28	29%
4	4. Markers, edge delineation	28	29%
1b	15. Typical cross sections, adequacy	27	28%
2	2/1. Visibility	27	28%
1a	6. Access to property and development	26	27%
1b	17. Roadway layout for traffic management	26	27%
2	3. Correctness of speed design	25	26%
2	5. Relationship to other nearby intersections	24	25%
5	5. Temporary traffic control / Management	23	24%
4	3. Other Signs - incl. distractive (non-road)	22	23%
2	7. Traffic signals	21	22%
2	8. Stop and give way signs	21	22%
5	3. Traffic Management	20	21%
1a	2. Drainage	20	21%
1a	4. Landscaping, general	20	21%
1b	22. Surface, skid resistance	20	21%
1b	25. Natural features	20	21%
1b	16. Effect of Cross Sectional Variation	19	20%
3	1. Median barriers	19	20%
1a	1. Changes since previous stages	18	19%
1a	9. Staging of works	17	18%
1a	10. Significant adjacent developments	16	17%
3	5.. Solid Vegetation	16	17%
1a	5. Services - buried and overhead	15	16%
3	4. Bridge & culvert parapets, underp.soffits	15	16%
1b	23.Contrast with markings	14	15%
1a	8. Staging of scheme	13	14%
5	2. Operation	12	13%
1a	7. Future widening &/or realignments	12	13%
5	1. Buildability	12	13%
1a	11. Batter & fill stability incl. surface effects	10	10%
5	4. Network Management	9	9%
1a	3. Climatic conditions	9	9%
5	6. By-law requirements (P)	9	9%
3	6. Verandahs	7	7%
6	6. Safety aspects not covered	1	1%

TABLE 2 - TOPICS OF WHICH INCREASED AWARENESS

Few respondents were more aware of by-law requirements, verandahs, network management, batters and fill stability (though oddly enough this topic certainly featured in the sample of safety audits reviewed in the Canterbury area!)

The list would be a good topic for a round table discussion. One possible conclusion is that the increased awareness is related partly to the importance placed on the topics in the mind of the respondent, and this may also be related to the potentially serious nature of any shortcomings in design. These matters may have also been more commonly detected in safety audits. However, the question was not phrased in a way to elicit this particular information and may possibly await a future questionnaire.

7. COMMENTS ON SAFETY AUDIT

As might be expected, an invitation to comment on the system and policy resulted in the articulate sample responding with a large number of pertinent comments. (Safety auditors must be by definition articulate!)

All comments have been listed in appendix 2, but by way of introduction to a short commentary, the following classification was used:

- Positive comments about the system (9 items)
- Critical comments or suggestions about improving the system (34 items)
- Positive comments about team composition and experience (3 items)
- Critical comments about team composition and experience (23 items)
- Comments about the designer or client (10 items)

7.1 Positive comments about the system

These comments listed the benefits of safety audit in greater awareness of problems, and the use of a systematic approach. The small number of responses in this category probably indicates that these aspects are accepted and do not need to be repeated.

7.2 Critical comments or suggestions about improving the system

In this case, however, the invitation to comment drew a large number of responses. There is a wide range of topics and at this stage the responses have not been sorted into sub-topics. nevertheless, there is a preponderance of topics to do with the following:

Checklists - need for simplicity

Dis-benefits in adverse effects of too rigid an application of safety audit (eg Congestion, costs, not a substitute for good practice)

Need to review the system, or elements of it

Design standards need reviewing

Not enough audits carried out, and not enough on small jobs, and too few local authorities.

Lack of follow-up

Lack of funds

Difficulties in urban areas

7.3 Positive comments about team composition and experience

Advantage of using different auditors, and keeping independent

7.4 Critical comments about team composition and experience

Lack of training, need for qualification

Lack of skill

Lack of design experience

Cost of safety audits

Need for more auditors

Lack of design or technical experience

Variability of reporting,

Over zealousness results in exaggeration

7.5 Comments about the designer or client

Lack of feed back

Delays in feed back

Lack of involvement or liaison between designer and auditor

7.6 Discussion of the responses

There appears to be a significant number of involved persons who are critical of the system, and three factors seem to stand out as aspects needing review. These are the composition and skill of the team, the lack of feedback to the auditor, and the need to expand the system either by making safety audit compulsory, or expanding into local authorities.

8 COMPARISON BETWEEN THE TWO GROUPS INVOLVED AND NOT INVOLVED IN GEOMETRIC DESIGN

The questionnaire was not designed with this comparison in mind but it may be interesting to compare which topics the non-involved group (who ticked the list as they did believe they were more aware of safe design as a result of the process) with the involved group.

The comparison is made in table 3 over, to make clear what differences there where. To facilitate comparisons a large chart is available as an additional resource to this report. (Being relatively large it is more convenient to handle it separately.)

It was hoped to illustrate areas in the non-involved group in which greater increased awareness had resulted.

As might be expected, the results showed a greater scatter than the first group (still in descending order of increased awareness). However, surface skid resistance, and effect of cross sectional variation stood out particularly, with drainage, speed, poles and shoulders to a lesser extent. It could be argued that these are, in general, the topics which engineers involved with building and operating roads rather than designing them might find of greater potential for learning.

9. AUTHOR'S CONCLUSION

It is not the purpose of this pilot questionnaire to make any formal recommendations. However, it is apparent that there is a groundswell of discontent with the performance and cost of some teams or members of teams and related requests for training or qualifications. There is a firm request for more feed back to auditors

The criticism of audit teams and the lack of any guarantee of competence looks to be a topic worth pursuing.

The question of feed back looks to be a topic worth considering if and when the system is reviewed.

Perhaps a data base will formalise recording and feed back.

As for the questionnaire, it looks to have been a worthwhile exercise and has resulted in a wealth of comments about the system which could be of use in any review of safety audit policy and application. One additional step which may be worth while is to contact at random a number of group members who have not responded. This would improve the confidence in the responses, particularly if this sample has little or no involvement in safety audit.

TOPIC FOR WHICH GREATER AWARENESS - BOTH GEOMETRY INVOLVED AND NOT INVOLVED	% OF REPLIES -FROM RESPONSES INVOLVED IN GEOM.	% OF REPLIES - FROM RESPONSES NOT INVOLVED IN GEOMETRIC DESIGN
Traffic Signs - pos. & appropropriateness, size	50	30
Appropriateness of design speed adopted	39	35
Visibility, sight distances	38	39
Readability by drivers & other users	38	30
Layout, geom. des. incl. pavmnt markings	38	26
Geom. of horizontal & vertical alignment	36	30
Signs and markings	36	39
Markers, edge delineation	36	17
Departure from Standards & Guidelines	34	9
Lighting	33	26
New/existing road Interface	32	30
Guardrailing (vehicle or pedestrian)	31	30
Typical cross sections, adequacy	31	26
Shoulders, edge treatment, k'side controls	30	26
Visibility	29	26
Poles & similar obstructions	28	39
Temporary traffic control / Management	28	22
Access to property and development	28	17
Roadway layout for traffic management	27	26
Correctness of speed design	27	30
Roundabouts, islands, ped. refuges	26	30
Installed hazards	26	26
Other Signs - incl. distractive (non-road)	25	17
Traffic restrs, tr. calming (all roads)	24	26
Traffic signals	23	26
Drainage	22	13
Services - buried and overhead	21	9
Natural features	21	13
Relationship to other nearby intersections	20	22
Stop and give way signs	20	22
Traffic Management	20	22
Landscaping, general	20	17
Staging of works	19	13
Surface, skid resistance	19	17
Median barriers	18	26
Bridge & culvert parapets, underp.soffits	17	17
Changes since previous stages	16	17
Future widening &/or realignments	16	9
Significant adjacent developments	15	9
Effect of Cross Sectional Variation	15	26
Contrast with markings	14	17
Solid Vegetation	13	13
Buildability	12	0
Climatic conditions	12	4
Batter & fill stability incl. surface effects	12	4
Staging of scheme	10	9
Operation	9	17
Network Management	9	9
By-law requirements (P)	9	4
Verandahs	7	4
Safety aspects not covered	1	

TABLE 3 - COMPARISON BETWEEN RESPONSES ABOUT IMPROVED AWARENESS - GEOMETRICALLY INVOLVED AND NOT INVOLVED.